

# Critical review: a summary of the current state-of-practice

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## Abstract

**Purpose** Much collective wisdom and experience have been gained as an increasing number of Life Cycle Assessment (LCA) reviews are conducted. However, specifics on how and when to conduct critical review of LCA studies are still lacking. Toward this need, a technical session entitled “LCA Critical Review” was held during the Life Cycle Management (LCM) conference in Gothenburg, Sweden, 26 August 2013. The goal of the session was to have experts address LCA critical review as well as engage attendees in discussing gaps in the current guidance and how the review process can be improved.

**Methods** The LCM session consisted of six presentations followed by open discussion with all session attendees. This paper begins with a review of the current state-of-the-practice in LCA critical review (CR) followed by a summary of the LCM session. It concludes with suggestions for how the newly drafted technical specification, ISO TS 14071 Critical review processes and reviewer competencies, can be improved as it is being developed.

**Results and discussion** ISO TS 14071 promises to provide additional guidance to move the practice forward. But at only eight pages in length, its potential effectiveness appears moderate. Additional detailed guidance is needed to move the critical review process toward increased uniformity and clarity of practice, for example, when critical review is necessary.

**Conclusions** A session on LCA critical review is planned to be held during the Life Cycle Management 2015 conference which will occur in Bordeaux, France (<http://lcm2015.org/>). Discussion on these issues related to LCA review will be continued.

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## 1 Introduction

Critical review has existed almost as long as life cycle assessment (LCA) itself. The intent of reviewing the conduct and reporting of an LCA is to further improve the study, remove serious errors, and deter deceptive practice, especially in the case of comparative studies. Although “peer” review for LCA studies was first proposed in the 1993 SETAC guidelines “A Code of Practice” (Consoli et al 1993), the first detailed guidance for critical review of LCA was not published until 1997 (Weidema 1997; Klöpffer 1997). The international standards series for LCA, originally developed between 1996 and 2000, and since updated to ISO 14040 and ISO 14044 in 2006, has addressed the issue and makes review a requirement for an LCA study. ISO 14040 describes, among other things, three types of “critical review” which are optional in general, but mandatory “for LCA studies used to make a comparative assertion disclosed to the public.” Additionally, since 2006, the minimum number of experts in a “review by interested parties” is now three (including the chair).

Much collective wisdom and experience have been gained with the conduct of reviews in practice. However, specifics on how and when to conduct critical review of LCA studies are still lacking. This has led to the development of additional guidance under ISO TS 14071.<sup>1</sup> The intent of this proposed international technical specification (expected completion in

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<sup>1</sup> ISO/PDTS 14071 Environmental management—Life cycle assessment—Critical review processes and reviewer competencies: Additional requirements and guidelines to ISO 14044:2006b, technical specification under development; 2013-09-2.

2014) is to provide requirements and guidelines for conducting a critical review and the competencies required (Finkbeiner 2013).

This paper begins with a brief summary of the current state-of-the-practice in LCA review, as directed by the ISO 14044 standard. Next, a summary is given based on six presentations and open discussion from a technical session entitled “LCA Critical Review” which was held during the Life Cycle Management conference in Gothenburg, Sweden, 26 August 2013. The goal is to identify existing gaps in guidance and weaknesses in how reviews are planned and conducted in order to propose how the practice can be strengthened. Suggestions are offered on how to improve the ISO 14071 Technical Specification, on critical review processes and reviewer competencies, as it is being developed.

## 2 ISO-Defined LCA review

First, we need to address the terms “critical review” and “verification” which tend to be used interchangeably, even though they are philosophically different (Grah1 and Schmincke 2012). “Critical review”, like scientific peer review, checks the scientific capacity of a study and the appropriateness of methods and assumptions. In comparison, “verification” is an audit exercise and is the validation of conformance<sup>2</sup> against specified requirements, based on an evidence-based approach supported by principles of objectivity and repeatability (see also ISO 19011:2011). Unlike verification, critical review does not rely on objective evidence, but instead relies on expert judgment about LCA methodology and practice. The well-known five criteria presented by ISO 14044 clause 6.1 (see box) for a critical review are not operationalizable in the same way verifiable requirements are.

ISO 14044 (2006b) specifically identifies five requirements in the critical review process

### Clause 6.1 General

The critical review process shall ensure that:

- the methods used to carry out the LCA are consistent with this international standard;
- the methods used to carry out the LCA are scientifically and technically valid;
- the data used are appropriate and reasonable in relation to the goal of the study;
- the interpretations reflect the limitations identified and the goal of the study; and
- the study report is transparent and consistent.

<sup>2</sup> The word “conformance” is preferred over “compliance” which implies agreement with some external authority.

ISO 14044 (2006b) defines “critical review” as the “process intended to ensure consistency between a life cycle assessment and the principles and requirements of the International Standards on life cycle assessment.<sup>3</sup>” Since the ISO standard specifies “critical review,” this terminology is used in this paper even though the intent of current LCA reviews may be more in line with a checklist-type approach to verify conformance with the ISO standards.

### 2.1 Conduct of an LCA review

The ISO 14044 standard requires that the scope of the study defines whether a critical review is necessary and, if so, how to conduct it, the type of critical review needed, and who would conduct the review, and their level of expertise. The standard is very specific when it comes to review of results that are intended to be used to support a comparative assertion intended to be disclosed to the public. In order to decrease the likelihood of misunderstandings or negative effects on external interested parties, a panel of interested parties shall conduct critical reviews on these types of studies.

Clause 6.2 of ISO 14044 indicates that a critical review may be carried out by a single internal or external expert. In either case, the expert must be independent of the LCA. Under clause 6.3, critical review may also be carried out by a panel of interested parties. In such a case, an external independent expert should be selected by the original study commissioner to act as chairperson of a review panel of at least three members. Based on the goal and scope of the study, the chairperson should select other independent qualified reviewers. This panel can include other interested parties who are affected by conclusions drawn from the LCA, such as government agencies, non-governmental groups, industry competitors, and affected industries.

Typically in practice, members of the review team (also known as the panel) bring a combined expertise that offers complete coverage of all aspects involved in conducting an LCA. At a minimum, these specialties must include knowledge in the following areas:

- Conformity to the ISO standard at goal and scope definition;
- Data/inventory (LCI) relevant to the industry sector(s) being studied;
- Life cycle impact assessment (LCIA) methods, data and modeling of relevant impact categories; and
- Overall flow and management of the review process.

<sup>3</sup> The definition in ISO 14044 for critical review (section 3.45) includes  
NOTE 1 The principles are described in ISO 14040:2006a, 4.1 and  
NOTE 2 The requirements are described in this International Standard.

While each member of the panel reads the whole report, the depth of the critical reading may and should differ. Sometimes, one member of the review team is a technical specialist for the product, industry, or production technology which is in the focus of the study; this member is not necessarily an LCA expert, although it is usually better that all members are familiar with the approach (Klöpffer 2005, 2012).

The expert review of LCAs requires a close (as in intimate) and open cooperation between the commissioner of the study, the practitioner, and the reviewer or the review team. All identities are known, unlike the peer review of scientific journals, which are often conducted in a single blind approach (the reviewers are anonymous). LCA critical review is also much more time consuming.

The review statement and review panel report, as well as comments of the expert and any responses to recommendations made by the reviewer or by the panel, are to be included in the LCA report.

## 2.2 Review of data

An important aspect concerning quality and credibility of any LCA is access to the underlying inventory data. In fact, the confidentiality of sensitive data is the most important reason for conducting a professional critical review. ISO 14044 does not directly describe data review; however, draft ISO TS 14071 indicates that the critical review should cover all aspects of an LCA, including data and calculation procedures: “The critical review should cover all aspects of an LCA, including data, calculation procedures for linking the unit processes into product systems, life cycle inventory impact assessment methodologies, characterization factors, and calculated LCI and LCIA results.”

However, since not all data are publicly available, or they are published in a highly aggregated form, reviewers have to judge data quality and appropriateness, for example, by random sampling or tracking of calculations. In order to do so, they have to have access to the data, and the commissioner and practitioner must provide this access. This may be complicated if third parties provide data or are not prepared to reveal confidential issues. Subcontractors have to be included in data transparency for the review team or at least for one member of the panel responsible for data quality.

## 2.3 Timing

Critical review can be conducted at various stages of completion of the LCA study. ISO 14044 does not elaborate on this issue. However, draft ISO TS 14071 offers guidance if the review is performed concurrently or at the end of the study (i.e., post-study):

- If the critical review is performed at the end of the LCA study, the process starts when the draft LCA report is provided to the reviewer(s).
- If the critical review is performed concurrently with the study, the process starts as early as the study commissioner and the practitioner decide. The various milestones at which the reviewer(s) may be asked to submit comments and recommendations are:
  1. The goal and scope definition;
  2. Inventory analysis, including data collection and modelling;
  3. Impact assessment;
  4. Life cycle interpretation; and
  5. Draft LCA report.

The process choice does not change the deliverables of the critical review process. In all cases, the critical review process shall clearly define and document its assessment of choices made by the study practitioners in areas including boundaries, functional unit, data, allocations, indicators, and so on.

## 3 “LCA Critical Review” session during the Life Cycle Management 2013 Conference in Gothenburg, Sweden

During the Life Cycle Management conference held in Gothenburg, Sweden, a session entitled “LCA Critical Review” was held on 26 August 2013. The stated aim of the session was to facilitate discussion on the lack of a standardized review process, as well as the role of practitioner certification, the conduct of quality reviews of LCA datasets and databases contained in publicly available reports and journal articles, and how to approach reviewing LCA methodology and applications. The coauthors and titles of the six presentations are shown in Table 1. The presenters’ names are underlined. The conference proceedings are available at <http://conferences.chalmers.se/index.php/LCM/LCM2013/schedConf/presentations>.

The session was highly successful in meeting the intended goal. The speakers were excellent and informative; the room was packed to overflowing, and the questions and discussion that were generated were high caliber. From the questions and discussion, it was apparent that numerous people in the room had experience serving on critical review panels.

### 3.1 Key messages from the LCA Critical Review Session, 26 August 2013

Following is a discussion of the key messages, a combination of reflections and questions, raised by the presenters during their presentations and by attendees during the subsequent

**Table 1** Session at the LCM 2013 Conference: “LCA Critical Review”

Session chairs: Mary Ann Curran, Steven B. Young
The Critical Review according to ISO 14040+44—How and why it came about.
<u>Walter Klöpffer</u> LCA Consult & Review, Germany
International survey on critical review and verification practices in LCA with a focus in the construction sector
<u>Sébastien Lasvaux</u> <sup>1</sup> , Yann Leroy <sup>2</sup> , Capucine Briquet <sup>2</sup> , Jacques Chevalier <sup>1</sup>
<sup>1</sup> Université Paris-Est, Centre Scientifique et Technique du Bâtiment (CSTB), France; <sup>2</sup> Laboratoire Genie Industriel—Ecole Centrale Paris, France
Guidance for conducting collaborative critical peer review using co-design tools and reviewer profiles
<u>Stephane MOREL</u> <sup>1,2</sup> , Philippe OSSET <sup>3</sup> , Sarah ERTEL <sup>4</sup> , Franck AGGERI <sup>2</sup>
<sup>1</sup> Renault SAS, France; <sup>2</sup> Mines ParisTech, CGS, Paris, France; <sup>3</sup> Solinnen, Paris, France; <sup>4</sup> Be-linked, Business & Community Intelligence, Paris, France
Radically reducing the costs of panel critical reviews according to ISO 14040
<u>Bo Pedersen Weidema</u> <sup>1,3</sup> , Kim Christiansen <sup>2</sup> , Gregor Wernet <sup>3</sup>
<sup>1</sup> Aalborg University, Denmark; <sup>2</sup> Danish Standards, Denmark; <sup>3</sup> The ecoinvent Centre, Switzerland
Critical review of LCA—Essential for quality and understanding
<u>Matthias Schulz</u> , Ivo Mersiowsky DEKRA Consulting GmbH, Germany
LCA critical review experiences and suggestions for improvement
<u>Fredy Dinkel</u> , Cornelia Stettler, Emil Franov Carbotech AG, Switzerland

open discussion period. Three themes are presented: The Reviewers, The Review Process, and Managing the Outcome of the Review.

### 3.1.1 The reviewers

The first question raised was how many reviewers are needed to conduct a review? Three are required by ISO, but are two sufficient, especially in the case of small companies with limited budgets? Then, the question becomes, where do we find (qualified) reviewers? Reference was made to the “usual LCA reviewers” meaning that a small pool of reviewers is being called on repeatedly. In addition to overtaxing this limited pool, interested parties may not always be included. Stephane Morel of Renault presented the idea of soliciting the participation of a large review panel that includes non-LCA expert stakeholders. The concept extends roles in the conventional critical review to include an “enabler,” acting as a facilitator who brings different perspectives together, and “observers” who provide a broader perspective to the group and provide more global context for the study.

### 3.1.2 The review process

Attendees recognized that it is common, and acceptable, for the review process to vary depending on the type of product being reviewed: reports, data, databases, and so on. There are also concurrent versus post-study reviews, although post-study reviews are more commonly done. Therefore, the number of iterations within the review cycle (i.e., repeating the review process as revisions are made) varies. The need for consistent criteria to guide different reviews was also clear. If publicly available, the review guidelines developed by DEKRA (presented by Schulz) could provide insight.

*The role of reviewers* Conventionally, the LCA critical review panel engages “interactively” (Klöpffer) as part of the triangle with the study commissioner and analysts, as described in ISO 14044. However, this triangle could be augmented, as described by Morel to add non-LCA experts and an “enabler” whose role would be to facilitate the expanded group.

Dinkel pointed out that the duty of the reviewer is not only to do an “administrative ISO check,” but to also be a discussion partner accompanying the LCA project. In general, forming formal partnerships with reviewers was viewed as a potentially good idea, but it was recognized that the reviewer as partner is not however a coauthor of the LCA study. As emphasized by Weidema and also highlighted by the following discussion, the panel is obliged to maintain a level of neutrality toward the LCA study. There is, therefore, a potential tension that develops between the panel’s objectivity versus its involvement as participatory partner in a study. The concern was that reviewers would slip into an analytical role and becomes vested in a project, thus risking their independence.

*Quality of the review* Lasvaux presented survey results from LCA experts that showed variability in the detail and quality of critical review activity. One highlight was that whereas review of methods and assumptions is usually performed comprehensively, the examination of data and therefore quantitative results is often limited. This may be a function of the critical review panel’s mandate, due to limitations of time, or as a result of weak transparency or poor accessibility to data sets. Schulz outlined review guidance that included a systematic checklist to ensure comprehensiveness and quality.

Weidema proposed steps to drastically reduce the cost of critical review without compromising thoroughness and overall quality. This procedure has three elements:

1. A fixed panel for all reviews—Each commissioner (e.g., a specific company or agency) could establish a fixed review panel (i.e., a pool) which would reduce

**Table 2** Coverage of selected issues in critical review (CR) within draft ISO TS 14071

Key issue	Where in ISO 14071	How well covered
Connecting review requirements with a study's scope	4.1 Scoping of the CR	14071 requires that interpretations reflect limitations identified and the goal of the study; however, no clear guidance is given to connect the review process directly with study scope
Indicating when CR is necessary, especially regarding comparative assertions	Introduction	Refers only to “the mandatory case of studies intended to be used in comparative assertions intended to be disclosed to the public” without further clarification
Timing of the CR (concurrent or post)	4.3.2 Type of CR 4.3.3 CR at the end of the study 4.3.4 Concurrent CR	Allows for CR to occur at any one of several milestones but does not provide guidance on determining applicability
Recognizing different types of reviews; do only LCA reports get reviewed?	4.3.4 Concurrent CR	Five milestones are identified for CR: goal and scope definition; inventory data; impact assessment; interpretation; and draft LCA report
Composition of the review team	4.7.1 Chairperson of a Critical Review panel	Selection of reviewers is left to the discretion of the chairperson
Number of reviewers	4.3.2 Type of CR	Allows for one or more internal or external reviewers but does not provide guidance on determining how many
Qualification of reviewers	5 Reviewer(s) competencies	Provides some guidance; requires reviewers be familiar with ISO LCA methodology and have the appropriate scientific and technical expertise; accreditation is not needed.
Identifying and locating reviewers	Not addressed	No guidance given on how to identify or locate reviewers
Inclusion of non-LCA experts	4.2.1 Selecting reviewer(s)	Other independent qualified reviewers and interested parties may be included
Formalization/professionalizing standing panels	Not addressed	Potential reviewer(s) shall submit a self-declaration, but standing panels are not mentioned
Managing the outcome, especially regarding enforcement	4.7.2 Reviewer	Guidance is limited to allowing reviewers to express disagreement on the CR statement and provide reasons.
Review of data, databases and verifying data integrity	Various	Refers to review of LCI of LCA studies but does not address the review of databases
Cost, efficiency and timeliness of CR process	Not addressed	No guidance provided

administrative efforts for composing, communicating with, and remunerating the review panels

2. An already critically reviewed background database—The most important element, is based on the 1:1 relationship between the number of LCAs and the number of unit processes in an LCA database, implying that every time you create a new unit process, you also create a new LCA (for the reference product of that unit process). In a situation where critical reviews have already been performed for each datasets that make up the complete global database, as well as for each algorithms that the database use for calculating the LCA results, then it would only be necessary to review the new “foreground” dataset or algorithms that you add for the decision context in which it is used. By limiting the critical review to the newly added data and algorithms, the costs are obviously radically reduced, while ensuring that every single dataset is critically reviewed enhances the overall quality of the review will be enhanced compared to the present-day situation.
3. A software-supported review procedure—Performing the reviews purely electronically in order to reduce travel costs and meeting time. This approach would have the added benefit of reducing environmental impacts of the review itself.

### 3.1.3 Managing the outcome of the review

**Critical review requirement and outcomes** Part of the discussion covered “When is critical review actually necessary?” Klöpffer had reviewed the ISO 14040/44 requirements, but the members of the audience suggested that the definition of “comparison” and “comparative assertion” are still confusing and open to debate.<sup>4</sup> The question of LCA used in Environmental Product Declarations (EPDs) was one example; even though a comparative assertion is not explicitly stated in a report, comparison is the aim of giving users data and information in an EPD.

A somewhat related discussion concerned the outcome of a critical review process. In particular, how can disagreements between parties be handled? What form of enforcement can be applied, if any? Furthermore, Klöpffer emphasized that, given that there are no single “correct” findings in LCA,<sup>5</sup> the resulting report cannot be “certified,” although this is a common notion (including one presented by BMW the next day at the same conference). The report form and “assurance” produced by the critical review is an area of valuable future attention. One

<sup>4</sup> Two camps clearly, and quickly, emerged on what constitutes comparative assertion, whether it is must be stated in the LCA report or if a reader-conducted comparison is sufficient to trigger the review requirement.

<sup>5</sup> That is, results depend on several factors, including which modeling assumptions, scope, and data are used.

direction is to move towards more detailed, sector-specific guidance for performing LCA studies, which might be a basis for auditable criteria as reference to future reviews.

## 4 Discussion

In general, the presentations and discussion during the LCM session highlighted the need for (1) increasing the quality of both people involved and data in LCA; (2) increasing the speed and efficiency; and (3) reducing the cost of critical review. There was some convergence of opinion around areas like the need for quality and rigor. However, there was robust debate on areas such as when critical review is necessary—particularly around what constitutes “comparative assertion”—and what role reviewers need to play. The key issues raised during the LCM session are mapped against the sections in the draft ISO TS 14071 where they are addressed, along with an indication on how well the new technical specification provides guidance (Table 2).

## 5 Conclusions

As mentioned in the Introduction, much collective wisdom and experience have been gained as an increasing number of LCA reviews are conducted. In addition, the draft ISO 14071 promises to provide additional guidance to move the practice forward. But at only eight pages in length, the effectiveness of the new technical specification appears moderate. Additional detailed guidance is needed if it is to move the critical review process toward better uniformity. Some issues identified here may be outside the scope of the technical specification, such as enforcement. In that case, an alternate mechanism for providing guidance for these areas is needed.

A session on LCA critical review is planned to be held during the Life Cycle Management 2015 conference which will occur in Bordeaux, France. Details about the conference can be found at <http://lcm2015.org/>. Discussion on these issues related to LCA review can be continued then.

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